SUPPORT FOR AMENDMENT

Claims 1 and 10 have been amended to recite the definition of the term "doped" as defined in the specification, page 2, lines 16-18. Claim 19 has been amended to recite its dependence on Claim 10, correcting a clerical error. New Claims 34-42 are supported by the specification. Claims 34, 35 and 38-42 are supported at least at page 6, lines 17-29. Claims 36 and 37 are supported at least at page 5, lines 1-3. No new matter has been added.

Attached herewith is a marked-up version of the changes made to the claims by this amendment. The attached page is captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE."

REQUEST FOR RECONSIDERATION

The rejections of the claims under 35 U.S.C. § 102 are respectfully traversed. Claims 1 and 10 have been amended to recite that the semiconductor nanocrystal is doped with a carrier selected from the group consisting of an electron and a hole, which is in keeping with the definition of the term "doped" in the specification.

Claims 1, 2, 4-13, 15-27, and 29-31 were rejected under 35 U.S.C. § 102(b) over Bhargava (U.S. Pat. No. 5,446,286), with Sher et al. (U.S. Pat. No. 4,529,832) applied as a background reference. The Examiner asserts that Bhargava teaches doping a semiconductor crystal with manganese (Mn), and that the addition of Mn to cadmium sulfide (CdS) results in the oxidation of elemental Mn to Mn^{2+} with a corresponding reduction of CdS. From these teachings, the Examiner concludes that "the semiconductor possesses one or more electrons as a carrier, and is therefore n-type," and that this is accomplished through an electrochemical process.

Applicants respectfully point out that an oxidation-reduction reaction involving manganese is not occurring in the Bhargava process. In the Bhargava process, the Mn^{2+} ion is added in its oxidized form to the semiconductor nanocrystal during the formation of the nanocrystal, as evidenced by the fact that diethyl manganese, properly having the formula $Mn(II)[CH_2CH_3]_2$, is used in the formation mixture (col. 7, lines 4-9). The Mn^{2+} ion merely replaces one of the host ions, for example cadmium (Cd^{2+}) or zinc (Zn^{2+}), in the semiconductor lattice. This process does not produce extra electrons or

holes in the semiconductor, and thus is not a "dopant" as recited in the claims. In fact, the Mn^{2+} ion serves as a trap for a free electron or a hole. The trapping properties of Mn^{2+} are evidenced by Figures 6a and 6b of Bhargava, which illustrate the transition of an electron or hole from the lattice (element 22) to the Mn^{2+} ion (element 23). Thus, Bhargava neither teaches nor suggests a semiconductor nanocrystal doped with an electron or a hole.

Claims 1-5, 10-16, and 21-24 were rejected under 35 U.S.C. § 102(a) over Gray et al. (U.S. Pat. No. 5,985,173), with Sher et al. applied as a background reference. The Examiner asserts that Gray et al. teaches n-doping with dopants such as Mn, silver (Ag) and copper (Cu) and teaches p-doping with chlorine (Cl). With respect to the n-doping, Gray et al. teaches the addition of divalent ions Mn^{2+}, Ag^{2+}, and Cu^{2+} in a manner similar to that taught by Bhargava (col. 1, line 66 through col. 2, line 9). These divalent ions merely replace the host ions, for example Cd^{2+} or Zn^{2+}, in the semiconductor lattice. This process does not produce extra electrons or holes in the semiconductor, and accordingly is not a "dopant" as recited in the claims. Thus, like Bhargava, Gray et al. neither teaches nor suggests doping with an electron to form an n-doped semiconductor nanocrystal.

With respect to the p-doping, Applicants point out that Gray et al. provides no teaching to provide Cl as a dopant beyond merely listing it as a possible ingredient. Gray et al. provides no evidence that Cl is incorporated into the semiconductor, nor does it distinguish such a conjectured doped particle as having different properties from the particles containing divalent ion dopants. Evidence against the inclusion of Cl as a p-dopant by Gray et al. is provided by the Gallagher et al. reference (U.S. Pat. No. 6,048,616), which was cited by the Examiner and is addressed more fully in the next paragraph. In Figure 1 of Gallagher et al., magnesium chloride ($MgCl_2$), diethyl manganese, and diethyl zinc are shown as ingredients in making semiconductor particles. Although chlorine is illustrated as present in the synthesis mixture, the final product is characterized as zinc sulfide (ZnS) doped with Mn, rather than doped with Cl or with a mixture of Mn and Cl. Thus, Grey et al. neither teaches nor suggests a semiconductor nanocrystal doped with an electron or a hole.

Claims 1, 2, 4-6, 8, 10-13, 15-17, 19, and 21-25 were rejected under 35 U.S.C. § 102(a) over Gallagher et al. (U.S. Pat. No. 6,048,616), with Sher et al. applied as a background reference. The Examiner asserts that Gallagher et al. teaches n-doping with Mn and cerium (Ce). Applicants point out that Gallagher et al. teaches the addition of divalent ions of Mn^{2+} in a manner similar to that taught by Bhargava (col. 4, lines 25-36). These divalent ions merely replace the host ions, for example Cd^{2+} or Zn^{2+}, in the semiconductor lattice. This process does not produce extra electrons or holes in the semiconductor, and accordingly is not a "dopant" as recited in the claims. Thus, Gallagher et al. neither teaches nor suggests a semiconductor nanocrystal doped with an electron or a hole.

Claims 1, 2, 4-13, 15-27, and 31 were rejected under 35 U.S.C. § 102(e) over Bhargava et al. (U.S. Pat. No. 6,241,819), with Sher et al. applied as a background reference. The Examiner asserts that this Bhargava '819 patent teaches n-doping with Mn. Applicants point out that Bhargava '819 teaches the addition of divalent ions of Mn^{2+}, as evidenced by the use of manganese chloride ($MnCl_2$) as the manganese source (col. 3, lines 6-42). These divalent ions merely replace the host ions, for example Zn^{2+}, in the semiconductor lattice. This process does not produce extra electrons or holes in the semiconductor, and accordingly is not a "dopant" as recited in the claims. Thus, Bhargava '819 neither teaches nor suggests a semiconductor nanocrystal doped with an electron or a hole.

Claims 1, 28-29, and 32-33 were rejected under 35 U.S.C. § 103(a) over Alivasitos et al. (U.S. Pat. No. 5,537,000) in view of Bhargava et al. (U.S. Pat. No. 6,241,819). The Examiner asserts that the doped semiconductor nanocrystals of Bhargava '819 can be combined with the electroluminescent device of Alivasitos et al. Applicants assert that such combination, even if proper, fails to provide each and every element of the claims. As noted above, Bhargava '819 does not teach or suggest semiconductor nanocrystals which are doped with an electron or a hole. Furthermore, the Office Action states that "Alivasitos et al. does not teach using doped semiconductor nano-crystals." Thus, the combination of the references does not provide a particle of a semiconductor nanocrystal doped with an electron or a hole, nor does the combination provide an electroluminescent display comprising such particles.

In conclusion, all of the grounds raised in the outstanding Office Action for rejecting the application are believed to be overcome or rendered moot based on the remarks above. Thus, it is respectfully submitted that all of the presently presented claims are in form for allowance. Should the Examiner feel a discussion would expedite the prosecution of this application, the Examiner is kindly invited to contact the undersigned.

Also submitted at this time is a Petition for Extension of Time for one (1) month.

Respectfully submitted,

10/7/02

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

1. (Amended) A particle, comprising:

a semiconductor nanocrystal,

wherein said nanocrystal is doped with a carrier selected from the group consisting of an electron and a hole.

10. (Amended) A method of making a particle, comprising:

adding at least one carrier to a semiconductor nanocrystal, to form a doped semiconductor nanocrystal;

wherein said carrier is selected from the group consisting of an electron and a hole.

19. (Amended) The method of claim 10 [1], wherein said particle comprises capping groups, on the surface of said nanocrystal.